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Photocurrent spectroscopy of excitons in ultraclean two-dimensional semiconductors – Part II ANDREY KLOTS, A.K.M. NEWAZ, BIN WANG, SOKRATES PANTELIDES, KIRILL BOLOTIN, Department of Physics and Astronomy, Vanderbilt University — We investigate excitonic physics in pristine suspended monolayer molybdenum disulfide (MoS_2) by means of low-temperature photocurrent spectroscopy. Measured photocurrent spectra exhibit a robust set of features, including peaks at $\sim$ 1.9, 2.1 and 2.9 eV. We interpret the peaks around 1.9 and 2.1 eV as due to optical absorption by direct band edge excitons of MoS_2 and ascribe the peak at 2.9 eV to an excitonic transition associated with the van Hove singularity of MoS_2. We interpret the nature and binding energy of these states using a combination of first-principles calculations and simple mathematical models. Furthermore, we use source-drain bias dependence of the photocurrent to investigate dissociation mechanisms of the excitons. Finally, we study the photocurrent response of bilayer and multilayer MoS_2 samples, as well as that of other transition metal dichalcogenides, such as $MoSe_2$ and WSe_2. Comparison of photocurrent spectra of these materials to that of monolayer MoS_2 allows us to investigate the effects of confinement and spin-orbit interaction.

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